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METHODS AND SYSTEMS FOR PROVIDING LAWFUL INTERCEPT OF A MEDIA STREAM IN A MEDIA GATEWAY

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Description

METHODS AND SYSTEMS FOR PROVIDING LAWFUL INTERCEPT OF A MEDIA STREAM IN A MEDIA GATEWAY

Technical Field

The present invention relates to methods and systems providing for the lawful intercept of communication signals. More particularly, the present invention relates to methods and systems for lawfully intercepting a media stream in a media gateway.

Background Art

Court-authorized access to telephone communications is an important tool for effective law enforcement. The introduction of new, digitally-based technologies, transmission modes, services, and features have made it increasingly difficult for law enforcement to conduct court-authorized electronic surveillance. Tapping calls in packet-based communication networks is particularly difficult because communication channels may be dynamically provisioned, such that there is no static line to tap, and because subscribers frequently move from one service provider to another. In packet-based communications networks, a media gateway is a network entity that switches media stream communications between its input and output ports and may

translate the media stream from one format to another format. Media gateways do not participate in call signaling and consequently do not maintain call state information. A media gateway controller performs signaling functions to establish and tear down calls across media gateways.

One problem with lawfully intercepting communications in conventional media gateways is that the protocols used to control connections in media gateways fail to provide an easily scalable mechanism for intercepting a media stream. For example, the MEGACO protocol, as described in ITU-T Recommendation H.248, includes commands for establishing and modifying contexts in a media gateway. A context is analogous to a call or a communications session between one or more parties. In a media gateway, a context is defined by its endpoints, referred to as terminations. Typically, a context has two terminations in the media gateway – one for communications to and from one party and one for communications to and from another party. The context also defines the direction of the communication, or media stream, between the terminations.

Figure 1 is a block diagram of a call context **100** having a lawful intercept through a media gateway modeled after a traditional three-way calling configuration. In Figure 1, the call context includes a bidirectional media stream **102** between Termination A **104** and Termination B **106** in a media gateway **107**. The media stream **102** carries media traffic between Termination A **104** and Termination B **106** and allows end users to communicate normally. A third termination, Intercept A **108**, is added to the context to accommodate

authorized monitoring of the media stream **102** by law enforcement. A TDM matrix **109** switches the media stream **102, 110** between the terminations. Normally, in a three-way call, the media stream between each termination is bi-directional. However, it is desirable for the media stream **110** toward Intercept A **108** to be one-way to prevent sound that might lead to the detection of Intercept A from being received by the other terminations. Thus, the media stream **110** toward Intercept A **108** is configured as a one way only stream to allow law enforcement to monitor the call without interference.

The MEGACO protocol provides for a topology descriptor, which is used to specify flow directions between terminations in a context. The default topology of a context is that each termination's transmission is received by all other terminations. Changing the association between terminations changes the topology of a context. Thus, to implement a lawful intercept using the topology descriptor, the lawful intercept media streams should be configured as one-way toward the law enforcement monitoring termination.

A shortcoming of this arrangement becomes apparent if more than one law enforcement agency is intercepting the media stream. As shown in Figure 2, three intercept terminations **108** have been added to the call context to accommodate interception by three different agencies. Changes made to the call impact each termination in the context. For example, if the end user on Termination A **104** wishes to add another termination to establish a three-way conversation or if one of the law enforcement agencies wishes to cease its interception of the call, the topology descriptor in the call context would need to

be updated, which involves several steps of MEGACO commands. This can be a cumbersome management task and may result in delays in establishing or terminating calls. Moreover, the media gateway may limit the number of terminations permitted in a call context. The limitation on terminations may limit the number of lawful intercepts that could be applied and may altogether prevent the application of a lawful intercept.

Accordingly, there is a need to provide a mechanism to permit the lawful intercept of a call while minimizing the increased load on call management resources.

Summary of the Invention

According to one aspect, the present invention includes a method for providing lawful intercept of a media stream in a media gateway. The method includes establishing a call context between a first termination and a second termination. The call context defines a call media stream between the first and second terminations associated with a call between first and second end users. The method also includes establishing a tap context, which contains at least one tap termination. The at least one tap termination refers to the target termination (first termination). The tap context defines a one-way media stream that carries a portion of the call media stream from the first termination to the tap termination.

According to another aspect, the present invention includes a media gateway with lawful intercept capability. The media gateway includes a plurality of network interfaces for sending and receiving media streams to and from

external networks. A plurality of voice processing resources are operatively associated with the network interfaces for processing the media streams received from the external networks. A controller is operatively associated with the network interfaces and the voice processing resources for controlling the network interfaces and the voice processing resources to establish a call context in the media gateway for a call between first and second end users. The controller, in response to a request for a lawful intercept of the call, controls the network interfaces and the voice processing resources to establish a tap context. The tap context includes at least one tap termination, which refers to one of the first and second terminations.

According to another aspect, the present invention includes a system for providing lawful intercept of a media stream in one or more media gateways. The system includes a media gateway controller for generating media gateway control commands for establishing contexts through media gateways for calls between first and second end users that use the media gateways. At least one media gateway is operatively associated with the media gateway controller for, in response to the commands from the media gateway controller, establishing a call context for a call between first and second end users. The call context includes first and second terminations initialized for bi-directional communications. In response to commands from the media gateway controller, the media gateway establishes a tap context that has at least one tap termination, which refer to one of the first and second terminations. The at least one tap termination receives the media stream of the mouth, the ear, or a mix of mouth and ear from one of the first and second terminations.

Accordingly, it is an object of the invention to provide a mechanism to permit the lawful intercept of a call while minimizing the increased load on call management resources.

Some of the objects of the invention having been stated hereinabove, other objects will become evident as the description proceeds when taken in connection with the accompanying drawings as best described hereinbelow.

Brief Description of the Drawings

Preferred embodiments of the invention will now be explained with reference to the accompanying drawings of which:

Figure 1 is a block diagram of a call context having a lawful intercept through a media gateway;

Figure 2 is a block diagram of a call context having three lawful intercept terminations through a media gateway;

Figure 3 is a block diagram of a media gateway that may be used to implement an embodiment of the invention;

Figure 4 is a flow diagram of a method of providing lawful intercept in a media gateway controller in accordance with the invention;

Figure 5 is a block diagram of a call context having a lawful intercept through a media gateway in accordance with the invention;

Figure 6 is a diagram of a communication network implementation of lawful call intercept using independent tap contexts in accordance with the invention; and

Figure 7 is a message flow diagram of an exemplary embodiment of lawful call intercept using independent tap contexts in accordance with the invention.

Detailed Description of the Invention

Figure 3 is a block diagram of a media gateway **301** that may be used to implement an embodiment of the invention. The media gateway **301** includes a control module **303** that functions as the command interface for a media gateway controller **305**. Commands from the media gateway controller **305** are received and processed by the control module **303**. The control module **303** may, in turn, provide instructions to or acquire information from other modules within the media gateway **301** in order to comply with the commands from the media gateway controller **305**. According to the present invention, the media gateway controller **305** may send commands to the controller **303** to effect lawful intercepts in accordance with the present invention. Exemplary commands and lawful intercept scenarios will be described in detail below.

The media gateway **301** may also include interfaces for sending and receiving media streams to and from a plurality of different types of networks. For example, the media gateway **301** may also include time division multiplexed (TDM) network interface cards (NIC) **307**. TDM network interface cards **307** send and receive media streams to and from external TDM networks. TDM network interface cards **307** may implement any suitable physical layer protocol for sending and receiving messages over TDM links.

For example, each TDM NIC **307** may terminate one or more TDM voice trunks.

In addition to TDM network interface cards **307**, the media gateway **301** may include packet network interface cards **309**. Each packet network interface card **309** may implement network layer functions and packet forwarding functions, including Internet protocol (IP) forwarding functions. In the illustrated example, different packet network interface cards are provided to connect to external Ethernet, Packet Over SONET (POS), and asynchronous transfer mode (ATM) networks, multi-protocol label switching (MPLS), frame relay, or any other suitable packet interface.

In Figure 3, the media gateway **301** includes voice server modules **311**, which may include circuitry for implementing one or more voice over packet protocols, such as RTP, AAL1, AAL2, or any other suitable voice over packet protocol. In order to switch packets from network interface cards **309** to the appropriate voice server module **311**, the media gateway **301** includes a packet matrix module **313**. The packet matrix module **313** switches packets under the control of the control module **303**. In addition to packet matrix module **313**, media gateway **301** includes a TDM matrix module **315** for switching data in TDM time slots between TDM NICs **307** and voice server modules **311**. TDM matrix modules **315** are also controlled by control module **303**.

In the lawful intercept scenarios described below, the media gateway may be similar in structure to the media gateway **301** illustrated in Figure 3. However, the present invention is not limited to performing the lawful intercept

routines described herein using a media gateway structure identical to that illustrated in Figure 3. Any suitable media gateway capable of receiving commands from an internal or external media gateway controller and establishing independent tap contexts for lawful intercepts based on the commands is intended to be within the scope of the invention.

Figure 4 is a flow diagram of exemplary control logic for a media gateway controller for providing lawful intercept in a media gateway in accordance with the invention. A media gateway controller sending appropriate messages to one or more media gateways may perform the steps involved in the lawful intercept procedure. The lawful intercept procedure may be performed during the set-up phase of the call, although law enforcement intercepts (taps) may be added or removed at any time during the call.

In step **401**, a media gateway controller (MGC) instructs a media gateway (MG) to create a call context that includes a first termination and a second termination. The MGC may send this instruction as part of the initial call set-up between the first and second terminations or when adding additional terminations to an existing call to support, for example, a three-way call or a multi-party teleconference.

In step **403**, the MGC determines if either the first or second termination is the target of a lawful intercept by consulting, for example, a database of court-authorized wiretaps. Such a database would likely include a unique identifier, such as a telephone number, of the party being tapped and a

reference to the law enforcement agency or agencies authorized to receive the tapped media stream.

If one or more taps are authorized, the MGC instructs the MG to create a tap context for each authorized tap (step **405**). In accordance with the invention, the tap context includes one or two law enforcement (or tap) terminations that contain information referring to a target termination. Media streams in the tap context are defined as one-way from the target termination to the tap termination. Separate media streams may originate from the ear (i.e., the media stream received by the target termination in the call context) and the mouth (i.e., the media stream originated by the target termination in the call context) of the target termination, or these media streams may be combined by a summing circuit and delivered to the tap termination as a single stream.

According to an important aspect of the invention, tap contexts may be created, modified, and released independently from the call context and independently from each other. By "independently," it is meant that tap contexts can be created and released without requiring changes to the topologies of the call context or the other tap contexts. This independence of tap contexts greatly reduces the administrative load and complexity on a media gateway controller and media gateway used to perform the tapping, especially when multiple tap contexts from different law enforcement agencies are used to monitor the same call. Exemplary extensions to the MEGACO protocol for establishing, terminating, and releasing independent tap contexts will be described in more detail below.

Step **407** completes the set-up of the call context by enabling send and received data streams between the first and second terminations. The timing of the execution of this step is independent of the creation of the tap context (step **405**). Thus, the first and second terminations may have initiated two-way communication before the tap context has been completely established.

Figure 5 is a block diagram of a call context **500** having a lawful intercept through a media gateway **507** in accordance with the invention. In Figure 5, the call context **500** includes a tapped context **501** and a tapping context **503**. The tapped context **501** includes a bidirectional media stream **502** between Termination A **504** and Termination B **506** in a media gateway **507**. The media stream **502** carries media traffic between Termination A **504** and Termination B **506** and allows end users to communicate normally. A TDM / Packet matrix **509** switches the media stream **502** between the terminations.

Intercept A **508** is added to the context to accommodate authorized monitoring of the media stream **502** by law enforcement. Intercept A **508** includes at least one tap termination **512**, **514**. More specifically, Figure 5 shows Intercept A **508** including TapTerm1 **512** and TapTerm2 **514**. It is desirable for the media stream **510** toward the at least one tap termination **512**, **514** of Intercept A **508** to be one-way to prevent sound that might lead to the detection of Intercept A **508** from being received by the other terminations. Thus, the media stream **510** of the tapping context **503** toward the at least one tap termination **512**, **514** of Intercept A **508** is configured as a one way only stream to allow law enforcement to monitor the call without interference. As will

be explained in greater detail below, the tap context contains the identity of the termination to be tapped (i.e., Termination A **504**) and a tapping mode. The tapping mode may be defined as mouth, ear, or mouth and ear. If the tapping mode is mouth, the tap termination receives a media stream that corresponds to the mouth portion of the tapped user's call. If the tapping mode is ear, the tap termination receives a media stream that corresponds to the ear portion of the tapped user's call. If the tapping mode is ear and mouth, the tap termination receives a mixed media stream that corresponds to the mouth and ear of the tapped user's call. In Figure 5, the tapping context **503** includes two media streams **510** from Termination A **504** to TapTerm1 **512** and TapTerm2 **514** of Intercept A **508**. One of these streams carries the mouth portion of the call and the other carries the ear portion of the call. As one would appreciate, if the selected tapping mode was mouth and ear, only one media stream **510** would be established between Termination A **504** and Intercept A **508**. Similarly, the tapping agent may only be interested in a portion of the call and may set the tapping mode to either mouth or ear to monitor the portion of interest. In this case, only one media stream **510** would be established between Termination A **504** and a tap termination of Intercept A **508** as well.

Figure 6 is a diagram of a communication network implementation of lawful call intercept using separate associated contexts in accordance with the invention. The exemplary network **600** may be used to transport a call between User A **602** and User B **604**. User A **602** is connected to the network through a service switching point (SSP) **606** or an equivalent entity. Similarly, User B **604**

is connected to the network through SSP **608**. In a conventional network, SSPs perform various functions, including originating, terminating, and switching calls. In an exemplary embodiment, SSP **606** may comprise media gateway controller (MGC) **610** and media gateway (MG) **612**. Signaling information is transmitted from User A **602** to MG **612**, and forwarded by MG **612** to MGC **610** for processing. Depending on the particular signaling information received, the MGC **610** may forward the information to a destination SSP, such as SSP **608**, or instruct MG **612** to perform some function, such as modifying a context of a voice connection between User A **602** and User B **604**. Using the procedure described below, the MGC **610** may also instruct the MG **612** to create a tap context that includes a law enforcement agent **614**. To ensure that the law enforcement agent **614** can monitor all of the calls made and received by User A **602**, tap terminations **616** should be configured on the same SSP **606** as User A **602**. Thus, in Figure 6, User A **602** is connected to Termination A **618** of MG **612**. Termination B **620** terminates a trunk from SSP **608**. MG **612** also includes two tap terminations **616** for law enforcement agent **614**.

Figure 7 is a message flow diagram of an exemplary embodiment of lawful call intercept using independent tap contexts in accordance with the invention. The diagram depicts a simplified message flow for a call setup sequence using the ITU-T Recommendation Q.931 and ISUP protocols. One skilled in the art would recognize that the exemplary embodiment of the invention may be adapted for use with other equivalent signaling protocols,

such as SIP, SIP-T, BICC, H.323, MGCP, MEGACO etc. In the description that follows, network elements are referred to using the same reference numerals used in Figure 6. These references are made to assist in the understanding of the exemplary embodiment of the invention and not to limit the invention to any particular network configuration.

In Figure 7, User A **602** initiates a call to User B **604** by dialing the phone number of User B **604**. The phone number is received at the SSP **606** serving User A **602** and an initial address message (IAM) is sent from the SSP **606** to the MGC **610**. The MGC **610** responds by instructing the MG **612** to create a call context with User A **602** and User B **604** as terminations (step 1). It should be appreciated that in Figure 7, the termination descriptors have been simplified to indicate "TermA" or "TermB", rather than using the termination descriptors defined in the MEGACO standard, in an attempt to simplify the message flow diagram. Once the MGC **610** receives an acknowledgement from the MG **612** (step 2), the MGC **610** forwards the IAM to the SSP **608** servicing User B **604**.

The MGC **610** determines whether User A **602** is the target of lawful surveillance. This determination may be made in a number of ways, such as by consulting an internal database or by querying one or more government databases that contain lists of surveillance targets. If the MGC **610** determines that User A **602** is the target of lawful surveillance, the MGC **610** instructs the MG **612** to create a tap context (step 3). It should be appreciated that in Figure 7, the termination descriptor for the tap terminations has been simplified to

indicate "TapTerm" rather than using the termination descriptors defined in the MEGACO standard. The tap context includes one-way media streams from the intercept target (i.e., User A **602**) to the law enforcement terminations **614**. The ear and mouth of User A **602** may be sent to the law enforcement terminations **614** as separate media streams (indicated as "TapTerm/Mouth" and "TapTerm/Ear" in step 3 of Figure 6) or may be combined into a single stream using a summing circuit (not shown). Although Figure 7 shows the creation of a single tap context, multiple tap contexts may be created in a similar fashion to support surveillance by more than one law enforcement agency. The MG **612** indicates the creation of the tap contexts with a response message (step 4).

The ability to create an individual tap context that refers to an intercept target termination within an existing call context is a new feature provided by the present invention. In Figure 7, the ADD commands in steps 3 and 4 allow the MGC to specify two tap terminations and tapping modes. In response to these commands, the media gateway establishes one-way media streams to the specified tap terminations. Three tapping modes are presently defined: "mouth," "ear," and "mouth and ear." If the tapping mode is "mouth," then the tap termination receives the media stream corresponding to the mouth of (i.e., originating from) the tapped user. If the tapping mode is "ear," then the tap termination receives the media stream corresponding to the ear of (i.e., received by) the tapped user. If the tapping mode is "mouth and ear," then the tap termination receives a mixed media stream corresponding to the mouth and ear of the tapped user. The ADD commands in steps 3 and 4 provide separate

mouth and ear media streams, which are shown in Figure 6 as "TapTerm1" and "TapTerm2". The ability to specify separate tapping modes allows law enforcement agencies to identify the originator of portions of a conversation.

The steps taken by the MGC **610** and MG **612** in creating the tap context are independent of the SS7 call processing and of the steps taken within MG **612** to establish the call context. That is, while MGC **610** and MG **612** perform the steps needed to create the tap context, the SSP **608** serving User B **604** performs the steps needed to complete the connection of the call from User A **602**. For example, when the SSP **608** receives the IAM from the MGC **610**, the SSP **608** confirms that it is serving User B **604** and that User B **604** is idle. The SSP **608** formulates an address complete message (ACM), which indicates that the IAM has reached its proper destination and transmits this message back through MGC **610** to the SSP **606** serving User A **602**. At the same time, the SSP **608** sends a ring tone to User B **604**. When User B **604** answers, the SSP **608** sends an answer message (ANM) to the MGC **610**. The MGC **610** forwards the ANM to the SSP **606** serving User A **602**. The MGC **610** also instructs the MG **612** to modify the call context between User A **602** and User B **604** to permit two-way communication (steps 5 and 6).

In Figure 7, User B **604** ends the conversation by hanging up. The SSP **608** sends a release message (REL) to the MGC **610**. The MGC **610** instructs the MG **612** to remove the tap context (steps 7 and 8) and then remove the call context (step 9). The MGC **610** also sends the RELEASE to User A **602**. When the MGC **610** receives the response from the MG **612**

indicating that the call context has been removed, the MGC **610** sends a release complete message (RLC) to the SSP **608**.

Thus, the present invention includes methods and systems for providing for the lawful intercept of a media stream in a media gateway. The methods and systems include the independent creation of a tap context with one or two law enforcement terminations that refer to a target termination. The tap context provides for a one-way media stream from the target termination to the law enforcement termination. The tap context also provides for per-port tapping, which permits separate media streams to be created from the ear port and the mouth port of the target termination. Per-port tapping permits law enforcement to easily determine which portions of a conversation are attributable to each party of the call.

The present invention further provides for the creation of multiple tapping contexts to support tapping by multiple law enforcement agencies. Each of the tapping contexts can be created, modified, and released independently, thereby alleviating the need to reconfigure the call context to accommodate the creation or release of a tap termination.

The invention has been described with respect to an exemplary embodiment, which is intended to be illustrative, not restrictive. In light of this disclosure, those skilled in the art will likely make alternate embodiments of this invention. These and other alternate embodiments are intended to fall within the scope of the claims that follow.